

## Meeting of the Scripts Institute

### Minutes for

Monday, November 3, 2014

**Attendants:** Tom Palaima, Kevin Pluta, Joann Gulizio, JoAnn Hackett, Paula Perlman, Sara Kimball, Adam Rabinowitz, Alex Walthall, Jamie Aprile, Sarah Buchanan, Will Bibee, Aren Wilson-Wright, Tiffany Montgomery, and Jackie Dibiasie

The meeting commenced at 4:00 pm.

Kevin Pluta began the discussion with an introduction to the use of Reflectance Transformation Imaging (RTI). Considering the widespread interest in RTI among various members of the Scripts Institute, he felt there was a great opportunity here to discuss the use of this technology with reference to his work on the Linear B tablets and to compare notes with others using RTI for their own research purposes.

RTI was developed by the Packard Humanities Institute at the University of Southern California and is used to analyze surface textures. Though it is not a true form of 3D technology, it allows for the examination of surface texture using fairly low-tech equipment. Sarah Buchanan set up her RTI equipment which consisted of a DSLR camera, a tripod, a flash, spheres for calibration and a laptop computer. The set-up is minimal and photos are often taken from above. Jackie Dibiasie, however, noted that her work on in-situ graffiti from Pompeii and Herculaneum necessarily requires the photos to be taken vertically.

Pluta has been using RTI on the Linear B tablets from Pylos, currently housed in the National Museum in Athens, Greece. Over the course of two seasons of work during the summers, he and his team have taken RTI images of around 850 tablets. Approximately two and a half weeks of work this upcoming summer will be needed to complete the imaging of the Pylos tablet corpus. Pluta noted that post-processing, which involves stitching the digital images together, is the most time-consuming part of the process.

The procedure itself requires the use of a fixed camera with a moveable flash. For each picture, the angle of the flash is changed in regular intervals around the object. For the Linear B tablets, 54 photos are taken of each tablet, with the flash at a different angle each time. The number of photos, however, can range from 32 to 90, depending upon the level of detail required for the artifact.

The Linear B project also includes 3D imaging using structured light scanning. This procedure requires two lenses offset with one light source and measures differences in the light reflected. The most expensive equipment required for 3D imaging is the projector. Joanne Hackett asked if 3D scanning offered better quality images than RTI. Pluta replied that it is more useful for three dimensional artifacts and perhaps for imaging the reverse sides of Linear B tablets. However, incisions are not as clearly shown in 3D imaging. In order to obtain more accurate 3D images, the developers at USC stated that they would need 10X greater resolution than what they are currently using which would be very time consuming and would not be feasible to undertake given the time restrictions at the National Museum. Because their project is interested in treating the Linear B tablets as artifacts as well as written documents, they have opted to take lower resolution 3D images

and superimpose the higher quality RTI image of the inscriptions on top. Pluta then demonstrated the complete process.

Sara Kimball asked if they were using some device to move the flash around the tablets during photography. Pluta explained that they are using a hand-held flash and moving it at regular intervals. It is not required that the placement of the flash is entirely consistent each time, because the program can calibrate the differences. Adam Rabinowitz explained the calibration process where it calculates the perpendicular angles of the flash and then mimics the other angles. It involves some complex math but the most important part is that the intensity of the light should remain fairly consistent.

Once the images are taken, then RTI builder software is used to stitch the images together. At this point, the image can be viewed through RTI software and the light sources can be manipulated using various filters to obtain the best possible view of the inscriptions. Pluta demonstrated some of the filter types. One particularly useful filter is the Normals Visualization, which as Rabinowitz explained is a raw form of visualization that eliminates all background noise. Paula Perlman noted that many of the filters do not work well on stone artifacts or inscriptions. Tom Palaima asked if raking light was more useful for stone inscriptions. Perlman replied that it was.

Pluta then gave an example of how RTI images compare to traditional published photographs. The Linear B tablet F 51 has been the subject of much controversy, especially concerning whether the tablet contains the term *ma-ka* or *ma-qe*. Palaima explained that *ma-ka* has been interpreted by Louis Godart and other Linear B scholars to be an abbreviated equivalent of *Māter Gē* (“Mother Earth”); he, however, has argued that, in the context of this tablet, *ma-ka* is more likely the *nomen actionis* “for kneading.” Though the implications of whether or not this tablet attests to some type of Mycenaean Mother Goddess is important for the study of Mycenaean religion, the question may become moot if the reading of the second sign is in fact *qe*, instead of *ka*. The signs *ka* and *qe* are very similar; both contain a circle, but *ka* usually has a cross inside the circle, whereas *qe* has four horizontal lines. The problem originates with an early illustration of the tablet by Arthur Evans in which the sign clearly appears to be a *ka*. However, in the publication of the Knossos tablets, the line drawing depicts a sloppier version of the original, where it seems possible that the sign could in fact be *qe*. More recently, Yves Duhoux, a prominent Linear B scholar, photographed this tablet and based on his photo *qe* seems to be more likely. The real problem lies in the fact that traditional photographs can be misleading and even in Duhoux’s image, a vertical line is apparent which may be or may not be intentional. An RTI image of this tablet may help solve this issue and Pluta mentioned that perhaps he would undertake another RTI project involving the Linear B tablets from Knossos once the Pylos tablet project is completed.

At this point, we asked Buchanan to discuss the RTI project she is working on with Tiffany Montgomery, under the supervision of Rabinowitz. Buchanan and Montgomery are currently creating RTI images of various cuneiform tablets, cylinder seals and a boule, which are part of a collection in Classics department. They are using a dual light RTI viewer that manipulates two separate light sources. This program provides very clear images of the artifacts and can reveal various inclusions as well as surface damage. It also offers a spotlight feature useful for zooming in on details and a specular enhancement effect that focuses on surface texture and gives the surface maximum reflectivity. Perlman asked if they were using the same viewing software as Pluta. Buchanan replied that they were using the West Semitic Research software developed at USC, whereas Pluta uses RTI viewer from Cultural Heritage Imaging (CHI). Pluta explained that the West Semitic Research software was built off of the CHI software and early on differences between the two were significant. At this point, however, they essentially offer the same features. Palaima expressed concerns that advancements in technology would render RTI obsolete in the future.

Rabinowitz explained that one of the benefits of using RTI on artifacts was that it takes raw data from the object, and so long as the data was obtained using consistent methods, advancements in software could still utilize the raw data to provide better images. It would just be a matter of reprocessing the raw data using updated software. He also mentioned that CHI would be visiting UT in April to offer a demonstration of their software.

Palaima, using Munsell colors as an example, asked if different conditions during RTI photography would produce different results. Rabinowitz explained that it could, but the conditions under which the photography was undertaken could be reconstructed because such things like F-stop and calibrations would be recorded. Therefore, it is much more objective.

Concerning Perlman's earlier comment about the difficulties using certain filters on stone inscriptions, Rabinowitz mentioned that RTI images taken on Smithsonian squeezes of Old Persian documents are available online, which shows what bright white objects look like using RTI filters. Pluta asked Dibiasie if she had difficulties with her work on graffito since they are often inscribed on white surfaces. She noted that she did have some problems with reflections, especially for inscriptions on rounded surfaces such as columns, but she compensated by using a low light source and an increased range. Buchanan noted that for round artifacts, like columns, seals and cones, you can use a multi-view to stitch together two dimensional images and make them appear three dimensional. Jamie Aprile asked if it was possible to use a filter on the camera while photographing very white objects to cut back on the glare. Pluta replied that you could.

Pluta asked whether anyone had used infrared RTI on artifacts. Aren Wilson-Wright stated that he would like to use infrared on a few ink inscriptions, but he has not done so yet. Hackett wondered if infrared was done on the Deir Alla inscription.

Pluta mentioned that he has quite a bit of post-processing work for the Linear B project and research money to hire assistants to do the work. He asked the members to inform him of any graduate students that may be interested in this type of work.

Dibiasie briefly reported on her work at Pompeii and Herculaneum, mentioning one particular inscription which offers two different readings. She hopes that her RTI images may clarify the issue. Rabinowitz mentioned that Astrid Runggaldier and David Stuart in Art History were also doing RTI work on Mayan artifacts.

Rabinowitz expressed the need for us to obtain a dome to facilitate our RTI projects. Palaima asked what a dome would cost. Rabinowitz explained that the cost can vary significantly depending upon the size of the dome need and can range from \$4,000 to \$15,000. However, USC does allow institutions to borrow prototypes of their domes for \$300-\$500. Palaima and Pluta stated that it was possible for use to use our current grant money for this so we can test the dome on the artifacts from the Classics department.

Finally, we discussed who would be interested in presenting their research at the next meeting of the Scripts Institute. Palaima thought it would perhaps be appropriate to discuss the newly proposed decipherment of the Phaistos disk and the problems with this proposal.

The meeting adjourned at 5:15 pm.

Minutes were taken by Joann Gulizio.